

Cairo, Ill.: floating ice on 1st, 2d, 8th, and 14th. An ice dam formed at Bird's Point, Mo., on the 15th and remained intact until the 31st, when it broke.

Missouri River.—The Missouri was frozen throughout the month at Leavenworth, Kans., and to the northward.

Arkansas River.—Little Rock, Ark.: floating ice 17th, 21st. Mackinaw Strait.—Mackinaw City, Mich.: the strait froze over on the 1st, on the 2d the ice was about two inches thick.

Saint Olair River.—Port Huron, Mich.: floating ice on 2d, 4th, 6th, 8th, 10th, 11th, 19th. Navigation closed on the 12th. An ice bridge formed on the 20th.

Sacramento River.—Sacramento, Cal.: floating ice on the 14th, the first observed since 1854.

Columbia River.—Portland, Oregon: river froze over on 9th, closing navigation; river was still frozen on 26th.

Willamette River.—Portland, Oregon: river froze over on 13th; people crossed on ice on 15th; ice broke up on 25th; navigation resumed on 26th.

#### FLOODS.

Los Angeles, Cal.: the heavy rains of the 3d and 4th caused numerous washouts on the railroads in this section, causing suspension of travel.

Boisé City, Idaho: an ice-dam formed in Cottonwood Creek on the 24th, causing an overflow in the eastern part of the city. Some of the farmers in the valley near here lost considerable hay and grain by the freshet on the 25th. On the 26th the Idaho Central Railroad was submerged at Ten-Mile Creek, between Boisé City and Nampa, and no trains passed over the road on that date.

Fort Assinaboine, Mont., 30th: during the recent warm weather the rivers in this section have overflowed and some railroad bridges have been carried away by the flood. No mail has arrived for four days.

Eureka, Humboldt Co., Cal., 31st: owing to the recent very heavy rains the streams in this section have risen to unusual heights, and in some localities considerable areas have been flooded; bridges were swept away, and numerous washouts occurred.

Hydesville, Humboldt Co. Cal.: the heavy rains of the 29th to the 21st caused the rivers in this county to reach the highest stages known during the last nine years.

#### STAGE OF WATER IN RIVERS AND HARBORS.

The Ohio at Pittsburg rose continuously from the 1st to 8th, and, having risen about eighteen feet, was within seven-tenths of a foot of the danger line on the last-named date. This rise permitted large fleets of coal barges to move down the river.

Nashville, Tenn., 2d: the heavy rains of December 31st and January 1st caused the Cumberland River to rise 14.5 feet in twenty-four hours, giving a depth sufficient for navigation on both the upper and lower Cumberland. Navigation has been closed on account of low water since June 19, 1887.

Louisville, Ky.: the river was very low on the 1st, but by the 9th it had risen sufficiently to permit the running of the larger steamers. The river reached its highest stage on the 15th, when it was about ten feet higher than on the 1st.

In the following table are shown the danger-points at the various stations, the highest and lowest depths for January, 1888, with the dates of occurrence and the monthly ranges:

Heights of rivers above low-water mark, January, 1888 (in feet and tenths).

Stations.	Danger-point on gauge.	Highest water.		Lowest water.		Monthly range.
		Date.	Height.	Date.	Height.	
Red River:						
Shreveport, La. ....	29.9	24, 25	20.4	8, 9	17.3	3.1
Arkansas River:						
Fort Smith, Ark. ....	22.0	31	6.5	2	1.3	5.2
Little Rock, Ark. ....	23.0	15	5.8	6, 7	2.6	3.2
Missouri River:						
Omaha, Nebr. ....	18.0					
Leavenworth, Kans. ....	20.0					
Mississippi River:						
Saint Paul, Minn. ....	14.5					
La Crosse, Wis. ....	24.0					
Dubuque, Iowa ....	16.0					
Keokuk, Iowa ....	14.0					
Saint Louis, Mo. ....	32.0	31	15.5	1	3.5	11.8
Cairo, Ill. ....	20	20	27.9	1	1.8	26.1
Memphis, Tenn. ....	34.0	22	22.0	3, 4	1.8	20.2
Vicksburg, Miss. ....	41.0	26, 27	26.3	7, 8	1.3	17.6
New Orleans, La. ....	13.0	31	8.6	3, 10, 11	1.7	6.9
Ohio River:						
Pittsburg, Pa. ....	22.0	8	21.3	31	2.3	19.0
Cincinnati, Ohio ....	50.0	13, 14	34.4	5	8.8	25.6
Louisville, Ky. ....	25.0	15	13.1	1	3.2	9.9
Cumberland River:						
Nashville, Tenn. ....	40.0	22	23.0	1	3.4	19.6
Tennessee River:						
Knoxville, Tenn. ....	18	18	12.6	30, 31	2.9	9.7
Chattanooga, Tenn. ....	33.0	19	25.7	31	5.6	20.1
Monongahela River:						
Pittsburg, Pa. ....	29.0	8	21.3	31	2.3	19.0
Savannah River:						
Augusta, Ga. ....	32.0	2	25.0	31	8.3	16.7
Sacramento River:						
Red Bluff, Cal. ....		31	17.6	15-19	0.8	16.8
Sacramento, Cal. ....		24	17.6	20	8.5	9.1
Willamette River:						
Portland, Oregon ..		31	16.5	9	0.0	16.5

\* River frozen entire month. † Below bench-mark.

#### LOW TIDE.

Baltimore, Md., 28th.

#### ATMOSPHERIC ELECTRICITY.

##### AUORAS.

Moorhead, Minn.: an auroral arch was observed during the night of the 7-8th, being very brilliant at 6.30 a. m., at which time the arch had risen to an altitude of 22°; numerous streamers shot up to an altitude of 75°. The display began at 8 p. m. and ended at daylight.

Lyons, N. Y.: a fine aurora, with streamers, was observed from 8 to 10 p. m. on the 13th. During the morning of the 17th a diffuse aurora, with streamers at intervals, was visible from 3 to 4 a. m.

Saint Vincent, Minn.: an auroral arch was visible from 8 p. m. on the 7th until sunrise on the following day; before midnight the display consisted of a low, broad arch, with an altitude of 10°, and covered 100° of the horizon. At 7 a. m. the display was probably at its maximum, at which time huge flames of light rolled up to within 10° of the zenith.

Northfield, Vt.: a brilliant aurora was observed from 8.30 to 10.30 p. m. on the 13th. It consisted of streamers which seemed to radiate from the horizon; the central streamer was

located in the magnetic north and during the period of greatest brilliancy, from 9 to 9.15 p. m., it reached an altitude of 50°. The display covered about 50° of the horizon, and the color was like that of an electric light.

Auroras were also observed during the month as follows: 6th, Poplar River, Mont. 7th, Garden City, Webster, and Huron, Dak.; Northfield, Vt.; Saint Vincent, Minn.; Poplar River, Mont., and Nashua, N. H. 8th, Fort Totten and Bismarck, Dak.; Cornish and Orono, Me.; Saint Vincent and Duluth, Minn.; Fort Assinaboine, Mont.; Embarras, Green Bay, and La Crosse, Wis. 9th, Palermo, N. Y. 10th, Lansing, Mich., and Saint Vincent, Minn. 12th, Egg Harbor City, N. J.; Palermo, N. Y.; Eastport, Me. 13th, Mackinaw City and Marquette, Mich.; Saint Vincent, Minn.; Poplar River, Mont.; Friendship and Setauket, N. Y.; Spokane Falls, Wash. 14th, Fort Totten, Dak.; Saint Vincent, Minn.; Fort Assinaboine and Poplar River, Mont. 15th, Saint Vincent, Minn.; Embarras, Wis. 16th, Marquette, Mich.; Fort Assinaboine, Mont.; Egg Harbor City, N. J.; Lunenburg, Vt. 17th, Nashua, N. H.; Poplar River, Mont. 23d, Nashua, N. H.

24th, Saint Vincent, Minn.; Ardenia, N. Y. 25th, Gardiner, Me. 27th, Pekin, Ill. 28th, Palermo, N. Y.

#### THUNDER-STORMS.

Thunder-storms occurred as follows: Mobile, Ala., 1st; Alcatraz Island, Angel Island, Oakland, Presidio of San Francisco, and San Francisco, Cal., 4th; Red Bluff, Cal., 23d; Titusville, Fla., 1st; Limona, Fla., 18th; Savannah and Quitman, Ga., 1st; Globe and Salina, Kans., 5th; Manhattan, Kans., 6th; Liberty Hill, La., 15th; Conception, Mo., 4th; Pierce City, Mo., 6th; Charleston and Stateburg, S. C., 1st; San Antonio, Tex., 12th; Cedar Hills, 14th; Palestine, Tex., 18th.

#### ELECTRICAL PHENOMENON.

Fort Assinaboine, Mont.: there was a constant display of light on the wires during the storm of the 11th, and the wires in the telegraph office became almost unmanageable.

Huron, Dak.: during the storm of the 12th metals and other substances emitted electrical sparks. Severe shocks were felt by persons shaking hands.

Fort Maginnis, Mont.: during the storm of the 12th the atmosphere was very highly charged with electricity from 3 p. m. until midnight, interfering considerably with the working of the telegraph lines; upon touching any metallic surface shocks were felt.

#### MISCELLANEOUS PHENOMENA.

##### METEORS.

Orono, Me.: a meteor, apparently about one-fourth the size of the moon, was observed at 6.40 p. m. on the 4th; it started near the zenith and moved in direction south 40° east, disappearing when within about 40° of the horizon. Although the sky in the region of its path was cloudy at the time it illuminated the horizon with a bright light.

Fort Sill, Ind. T.: an unusually bright meteor was observed at 8.45 p. m. on the 4th; it started from about 75° above the southwest horizon, moved a little to the southwest, and disappeared when at an altitude of about 30°; during the passage of the meteor the southwestern sky was illuminated as though the full moon shone; it was visible for ten seconds. This meteor was also seen at Fort Reno, Ind. T., and was probably the same seen at Abilene, Tex., and Yates Centre, Kans.

Meteors were also observed as follows:

1st, Wythville, Va. 2d, Webster, Dak., and Yates Centre, Kans. 4th and 6th, Rappahannock, Va. 7th, Wytheville and Dale Enterprise, Va. 9th, Tribune, Kans. 10th, Lamar, Mo.; Woodstock, Md.; Dale Enterprise, Va.; Rappahannock, Va. 11th, Woodstock, Md.; Dale Enterprise, Va. 12th, Nashua, N. H.; Wytheville, Va.; Fort Stanton, N. Mex. 13th, Lead Hill, Ark., and Manhattan, Kans. 14th, Provincetown, Mass. 20th, Fall River, Mass. 23d, Dubuque, Iowa. 24th, Wytheville, Va. 27th, Washington City and Chicamcomico, N. C. 28th, Omaha, Nebr., and Woodstock, Md. 30th, Grand Junction, Colo. 31st, Variety Mills, Va.

##### MIGRATION OF BIRDS.

*Geese flying southward.*—Yates Centre, Kans., 1st, 3d; Chattanooga, Tenn., 3d; Kitty Hawk, N. C., 10th; Wilmington, N. C., 11th, 20th; Red Bluff, Cal., 23d.

*Geese flying northward.*—Red Bluff, Cal., 10th; Corsicana, Tex., 14th; Augusta, Ga., 21st, 27th; Globe, Kans., 29th.

*Brants flying southward.*—Kitty Hawk, N. C., 10th.

##### MIRAGE.

Corpus Christi, Tex.: at 3 p. m. on the 2d Mustang Island, twenty-two miles from this place, was plainly seen on the horizon, over Corpus Christi Bay; the phenomenon continued until 5 p. m. A similar display was observed from 11 a. m. to 4 p. m. on the 27th.

Fort Maginnis, Mont.: Mason Lake and its surroundings, situated about forty miles distant, were plainly seen from 9.45 to 10.45 a. m. on the 23d.

Webster, Day Co., Dak.: unusually fine displays of mirage were observed on the 29th and 31st; on the first-named date, Wobbay, and on the latter, Bristol, and their surroundings, were plainly seen.

Mirages were also observed as follows: Garden City, Dak., 29th; Cedar Keys, Fla., 21st; Tribune, Kans., 1st, 2d, 3d, 10th, 11th, 17th to 19th, 23d, 25th, 26th, 29th, 31st; Fort Maginnis, Mont., 23d; Poplar River, Mont., 14th, 17th, 20th, 21st, 28th, 29th; Marquette, Nebr., 2d, 10th, 18th, 26th, 29th to 31st; Corpus Christi, Tex., 28th.

##### PRAIRIE FIRES.

Fort Sill, Ind. T., 2d; Fort Reno, Ind. T., 4th.

##### SAND STORMS.

Willcox, Ariz., 3d, 4th, 10th; Fort Grant, Ariz., 4th, 10th, 18th.

##### SUN SPOTS.

Mr. H. D. Govey, North Lewisburg, Champaign Co., Ohio, observed sun spots as follows: 1st, 2d, 10th, 13th, 14th, 18th, 21st.

#### VERIFICATIONS.

##### CAUTIONARY SIGNALS.

Of the total number of cautionary and storm signals ordered during January, 1888, it was practicable to determine the justification or failure of fifty-four; justified, thirty-seven, or 68.52 per cent. Of the above, twelve were ordered for cautionary signals; number justified, seven, or 58.33 per cent. Forty-two storm signals were ordered; justified, thirty, or 71.43 per cent. Total number of direction signals ordered, fifty-six; justified, fifty-four, or 96.43 per cent. Number of signals ordered for easterly winds, eleven; justified, ten, or 90.99 per cent. Number of signals ordered for westerly winds, forty-five; justified, forty-four, or 97.78 per cent. Number of storms without signals, none. Number of signals ordered late, *i. e.*, after the justifying velocity had begun, twelve, or 22.22 per cent.

##### COLD-WAVE SIGNALS.

Total number of cold-wave signals ordered from Office Chief Signal Officer, two hundred and sixty-one; justified, one hun-

dred and eighty, or 68.97 per cent. Eighty-one cold-wave signals were ordered during the month by the Signal Service Officer at Saint Paul, Minn., of which, seventy-five, or 92.59 per cent., were justified.

##### INDICATIONS FOR 33 HOURS IN ADVANCE.

The percentages of verifications of the tri-daily indications for January, 1888, as determined from comparison of succeeding telegraphic reports are given in the table below.

The predictions for all districts east of the Rocky Mountains for January, 1888, were made by Junior Professor H. A. Hazen, except those for Minnesota, eastern and central Dakota, which were made at Saint Paul, Minn., by 1st Lieutenant Thomas M. Woodruff, 5th Infantry, U. S. Army, Acting Signal Officer; those for the Pacific coast districts were made at San Francisco, Cal., by 2d Lieutenant J. E. Maxfield, Signal Corps; the verifications for all districts were determined by Junior Professor O. F. Marvin: